Lat 39.73301 Lon -120.97704

Forest Health Protection
Pacific Southwest Region

Date: July 20, 2006
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To: District Ranger, Feather River Ranger District, Plumas National Forest

Subject: Evaluation of the Little Grass Valley Reservoir Recreation Area (FHP Report NE06-10)

At the request of Linda Morehouse Braxton, Assistant District Resource Officer, Feather River Ranger District, Danny Cluck, Forest Health Protection (FHP) Entomologist, and Bill Woodruff, FHP Plant Pathologist, conducted a field evaluation of the Little Grass Valley Reservoir Recreation Area on June 26, 2006. The objective of the visit was to evaluate the current forest health conditions within and adjacent to campgrounds/day use areas and to provide management recommendations as appropriate. These recommendations will assist with planning future activities, including campground renovations and vegetation and hazard tree management within the recreation area. Deb Schoenberg, Gary Rogers and Dan Roskopf accompanied us in the field.

Background

The Little Grass Valley Reservoir Recreation Area is located on the Plumas National Forest, near the community of La Porte, CA, at an elevation of 6400 feet. Precipitation for the site averages greater than 80 inches per year. The forested area in and around the campground is generally a Sierra mixed conifer type with white fir (*Abies concolor*) and lodgepole pine (*Pinus contorta var. murrayana*) as the dominant species, making up approximately 90% of both the overstory and understory. Jeffrey pine (*Pinus jeffreyi*), ponderosa pine (*Pinus ponderosa*), incense cedar (*Libocedrus decurrens*) and red fir (*Abies magnifica*) trees are scattered throughout the area and are mostly found in the overstory as limited regeneration is occurring for these species.

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Observations

The areas inspected were limited to the Red Feather campground, the Maidu boat launch area, the Blue Water swimming area, and along the roadsides around the lake. Other campgrounds within the Little Grass Valley Recreation area likely have trees affected by the same biotic agents as found in these areas.

Several biotic agents such as dwarf mistletoe, root disease, stem decays, and bark beetles are affecting white fir throughout the recreation area. Many of the older white fir trees have unhealthy crowns with dead tops, dead limbs and thin foliage and a few have recently been attacked and killed by the fir engraver beetle (*Scolytus ventralis*). Stumps of recently felled trees within the Red Feather campground were observed with extensive laminated decay at the root collar and had conks present, symptoms of *Heterobasidion annosum*, the causal agent of annosus root disease (Figure 1). These signs were also evident on two wind thrown white firs in the Red Feather campground. One of these wind thrown trees was also infected with Indian paint fungus (*Echinodontium tinctorium*) that had caused extensive decay throughout the bole (Figure 2).

Figure 1. White fir stump with decay and conks of *H. annosum.*

Figure 2. Wind thrown white fir infected with *H. annosum* and Indian paint fungus.

Lodgepole pine dwarf mistletoe (*Arceuthobium americanum*) has infected many lodgepole pine within the campground and has caused bole and limb swellings, brooming and reduced vigor as indicated by thinning crowns.

Western gall rust (*Peridermium harknessii*) and stalactiform rust (*Peridermium stalactiforme*) are infecting lodgepole pine and resulting in bole cankers that can reduce tree vigor and compromise the structural integrity of infected boles and limbs (Figure 3). One infected tree at the Maidu boat ramp had recently snapped off at a very old bole canker revealing advanced decay. Other lodgepole pines have significant decay at the root collar as evidenced by exposed sapwood and carpenter ant activity (Figure 4). Trees with this type of decay may have had previous injuries that exposed sapwood to fungal spores; however, the exact cause could not be determined.

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Figure 1. Lodgepole pine with bole canker caused by western gall rust.

Figure 4. Lodgepole pine with extensive decay at root collar as evidenced by carpenter ant activity.

There is evidence of mechanical injury on many trees resulting from campers hammering nails into trees and cutting into trees with hatchets or saws.

High foot and vehicle traffic is occurring in and around the campsites. This is evidenced by the lack of vegetation in many areas and is likely resulting in highly compacted soils around tree roots in addition to direct root damage.

Discussion and Recommendations

Trees in the Little Grass Valley Reservoir Recreation Area, similar to most forested campgrounds, are exposed to additional stress factors that can compromise their health and vigor. Firewood collecting sometimes leads to tree wounding from hatchets and saws, foot and vehicle traffic from campers can result in increased soil compaction and root damage, and the desire for screening between campsites can result in overstocking of understory trees.

Root decay caused primarily by *H. annosum* and heartwood decay caused primarily by *E. tinctorium* in white fir are the most serious conditions identified in the Little Grass Valley Reservoir Recreation Area. Many trees have been felled within the past few years that had previously succumbed to some combination of root disease and fir engraver beetle. Some of these trees were likely hazardous before they died. With this many trees affected in a campground, it is critical that the remaining live trees are evaluated and potential hazards identified. Treatment for a hazard tree (a defective tree located where it could kill or injure people or damage property if it fell) is to remove the tree or to keep people away from the tree. The most effective ways to keep people away from hazard trees are to move the facility (picnic table, campsite, toilet, etc) or construct barriers around the trees.

Identifying hazards by signing does not relieve the Forest Service from liability for injury or damage caused by known tree hazards. Liability can only be eliminated by closing hazardous areas or removing the hazard. Liability can be minimized by implementing an on-going tree hazard identification and treatment program for recreation areas. This program would involve periodically examining trees in recreation areas, removing or mitigating those deemed hazards and monitoring questionable trees over time.

For trees with branch swelling and brooms caused by dwarf mistletoe, depending on the degree of symptoms, consideration should be given to tree removal or at a minimum selective pruning within the crown to remove the dead or diseased limbs that could snap off and strike campers. Removing infected limbs will also reduce the number of seeds that can disperse and infect susceptible understory trees. Depending on the level of dwarf mistletoe infection, removal of infected limbs can improve the health and vigor of the tree as long as at least 50% of the original live crown remains after treatment.

Bole cankers on lodgepole pines caused by rust diseases should be inspected and monitored periodically for decay. Trees infected with these canker causing fungi can live for many years without developing decay in the bole. Evidence of rotten wood, insect boring holes and sawdust are good indicators that extensive decay may be present and that the tree has a high risk of failure.

Soil compaction within the campground may be partially responsible for predisposing the fir trees to root diseases and bark beetle attacks. Compacted soils tend to suffocate roots, limiting the available oxygen that is necessary for root growth and survival. Damaged and unhealthy roots cannot provide the upper portions of the tree with the water and nutrients it requires to maintain its natural defenses. Root damage is a long-term problem that may not reveal itself until several years after the damage has occurred. In order to minimize future soil compaction and root damage, campers should be confined to specific travel corridors from campsites to restrooms, water sources, and specific recreation areas. It is especially important to divert and limit foot and vehicle travel as much as possible from the root zones of trees.

Stands within the campgrounds would benefit by the removal of diseased trees and a reduction in stand density. When thinning trees in campgrounds where annosus root disease is present, it is recommended that you select for a mix of tree species and sizes with priorities for leave trees given to species other than true fir. In addition, when selecting trees for removal, preference should be given to trees infected with dwarf mistletoe, root disease, trees infested with bark beetles and trees with extensive human caused injuries. For root diseases it is reasonable to use the condition of the crown as an indicator of advanced decay. Although not always caused by root decay, a thin crown does indicate poor tree vigor. A tree with reduced photosynthesis is not able to maintain healthy roots as well as a tree with a full and healthy crown. In the presence of root disease, unhealthy roots will likely be overcome with decay faster than vigorously growing roots. For this reason, the thinner the crown of a tree in an area where root disease is present, the more likely it is that the roots have been weakened by decay.

Dense stands adjacent to campgrounds would also benefit from thinning. Trees should be thinned to a basal area appropriate for the site in order to improve stand health and vigor. To reduce the susceptibility to future bark beetle related mortality, stands should be thinned to densities that are 80% or less of "normal", effectively reducing tree competition for limited water and nutrients. Furthermore, selecting for more drought tolerant species such as Jeffrey pine and incense cedar over red and white fir will increase

species diversity and make the stand more resilient to disturbance agents such as insects, disease, and fire. Thinning can also decrease the need to enter stands to conduct salvage operations, decrease the amount of fuel loading and reduce the number of hazard trees. When planning such thinning, it should be recognized that this is an average to be applied across the landscape and some variability may be desired. Individual high value trees, such as mature pine, as well as pure stands of younger ponderosa and Jeffrey pine should benefit by having the stocking around them reduced to lower levels. In addition to reducing tree stress, thinning, especially of the understory, will somewhat reduce the risks and damage from any fire that might occur and provide a more defensible space for the campground.

Pure lodgepole pine stands should be thinned to 80 to 100 BA to reduce their susceptibility to bark beetle attacks. However, reducing the basal area in extremely dense stands in one entry can result in wind throw and/or snow breakage of residual trees, therefore, managers should expect to have an even lower stand density and increased fuels resulting from wind thrown trees within a few years of opening up the stand. Therefore, desired stocking levels in pure lodgepole pine stands may be best achieved through multiple entries over time.

It is important to note that when implementing tree removal or hand thinning in a recreational site, Region 5 direction calls for the treatment of all conifer stumps with a registered borate compound to reduce the probability of infection by *Heterobasidion annosum*, the causal agent of annosus root disease. Care also needs to be taken to minimize both wounding of residuals and site disturbance. If regenerating any openings created during thinning and hazard tree removal is desired, planting Ponderosa/Jeffrey pine, incense cedar or rust resistant sugar pine seedlings should be considered over natural regeneration of true fir and lodgepole pine, since these species are not hosts for the fir strain of annosus root disease or lodgepole pine dwarf mistletoe.

General Recommendations for Campgrounds

Maintaining and promoting healthy trees are important objectives for development plans in campgrounds. Care should be taken during future campsite, trail and facility construction to minimize negative impacts on the landscape. The following guidelines should be applied for areas under construction or in areas where future construction will take place.

- Tree density should be appropriate for the site. This will provide access to light, moisture and nutrients and allow the trees to better cope with their altered environment.
- Trees that will directly interfere with structures or that will be seriously damaged during construction or excavation should be removed.
- Leave a mixture of ages and species to provide a continual forest canopy over the years.
- Fence off individual or groups of trees before construction to negate or minimize root damage by soil compaction or trunk and root damage by equipment.

Protective fences should be placed, at a minimum, at drip line. Depending on the species, tree roots can exist within a radius two times the crown radius and encompass an area well beyond drip line. Drip line is defined by the outer edge of the foliage. Penalties for damaging trees should be incorporated into tree removal or construction contracts.

- Road or lot grades should be changed as little as possible. Grading damages roots and can set up conditions that favor soil erosion. It can also alter the contour such that the flow of surface and subsurface water is drastically affected.
- Trenches should always be dug away from tree roots.
- Do not back fill with earth or rocks around the trunks of trees.
- Avoid paving with either concrete or asphalt over root systems, or close to the trunks of trees.
- Use caution in applying wood preservatives and other chemicals to buildings. Trees and other plants have been killed by direct contact with them or as a result of their runoff in rainwater.
- Avoid leaving green pine slash on site to prevent the build up of pine engraver (*Ips pini*) beetle populations that may attack standing green trees.

Future construction or vegetation management activities that incorporate the above guidelines will help assure the existence of vigorous and healthy trees following project completion.

Despite the effectiveness of any long or short-term plans to prevent tree injury and mortality, some trees, through declining health, will eventually become hazards to the public. To minimize the risks associated with hazard trees, they should be identified and removed before they fail. The current practice for many National Forest campgrounds is to remove trees as they die. This eliminates the risk from dead trees but fails to address living trees that are infected with root disease, heart rot, and/or have a structural defect. These high-risk green trees are equally hazardous and should not be overlooked. Therefore, it is recommended that the Forest develop a hazard tree evaluation and monitoring plan for its campgrounds. At your request, Forest Health Protection can provided information and assist with the development of this plan. In the short-term, trees within the campground that have obvious stem decay, dead tops and/or large dead branches should be carefully evaluated and hazards removed or pruned as soon as possible. All standing dead trees within striking distance of campsites or campground facilities should be removed immediately.

Conclusion

Any future modifications to the Little Grass Valley Reservoir Recreation Area should incorporate a long-term vegetation management plan that includes a hazard tree evaluation and monitoring plan for campgrounds. The recommendations provided in this evaluation combined with input from the District and/or Forest silviculturist will help insure the continued presence of healthy trees that will provide shade, campsite screening and visual/aesthetic qualities for these recreation areas.

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Forest Health Protection can assist with funding for thinning and removing green material from overstocked areas within and adjacent to the Little Grass Valley Reservoir Recreation Area on a competitive basis. Funding is also available on a competitive basis for treating dwarf mistletoe infected stands, including the pruning of infected limbs. If you are interested in this funding please contact any of the Forest Health Protection staff for assistance in developing and submitting a proposal.

If you have any questions regarding this report and/or need additional information please contact Danny Cluck at 530-252-6431 or Bill Woodruff at 530-252-6680.

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Fir Engraver

The fir engraver attacks red and white fir in California. Fir engraver adults and developing broods kill true firs by mining the cambium, phloem, and outer sapwood of the bole, thereby girdling the tree. Trees greater that 4” in diameter are attacked and often killed in a single season. Many trees, weakened through successive attacks, die slowly over a period of years. Others may survive attack as evidenced by old spike-topped fir and trees with individual branch mortality. Although many other species of bark beetles cannot develop successful broods without killing the tree, the fir engraver beetle is able to attack and establish broods when only a portion of the cambium area has been killed.

Evidence of Attack

Fir engravers bore entrance holes along the main stem, usually in areas that are > 4” in diameter. Reddish-brown or white boring dust may be seen along the trunk in bark crevices and in spider webs. Some pitch streamers may be indicative of fir engraver attacks; however, true firs are known to stream pitch for various reasons and there is not clear evidence that pitch streamers indicate subsequent tree mortality or successful attack. Resin canals and pockets in the cortex of the bark are part of the trees defense mechanism. Beetle galleries that contact these structures almost always fail to produce larval galleries as the adults invariably abandon the attack. Pitch tubes, often formed when bark beetles attack pine, are not produced on firs.

Adults excavate horizontal galleries that engrave the sapwood; the larval galleries extend at right angles along the grain. Attacks in the crown may girdle branches resulting in individual branch mortality or "flagging". Numerous attacks over part or the entire bole may kill the upper portion of the crown or the entire tree. A healthy tree can recover if sufficient areas of cambium remain and top-killed trees can produce new leaders. The fir engraver is frequently associated with the roundheaded fir borer and the fir flatheaded borer.

Life Stages and Development

In the summer, adults emerge and attack new host trees. The female enters the tree first followed by the male. Eggs are laid in niches on either side of the gallery. Adult beetles carry the brown staining fungi, *Trichosporium symbioticum*, into the tree that causes a yellowish-brown discoloration around the gallery. The larvae mine straight up and down, perpendicular to the egg gallery. Winter is commonly spent in the larval stage, with pupation occurring in early spring. In most locations, the fir engraver completes its life cycle in 1 year, however at higher elevations 2 years may be required.

Conditions Affecting Outbreaks

Fir engravers bore into any member of the host species on which they land but establish successful galleries only in those that have little or no resistance to attack. Populations of less aggressive species like fir engraver are likely to wax and wane in direct relationship to the stresses of their hosts. Drought conditions often result in widespread fir mortality; however, attempting to determine when outbreaks will occur is difficult. Lowered resistance of trees appears to be a contributing factor. Overstocking and the increased presence of fir on sites that were once occupied by pine species may also contribute to higher than normal levels of fir mortality. Several insect predators, parasites and woodpeckers are commonly associated with the fir engraver and may help in control of populations at endemic levels.

Annosus Root Disease

Heterobasidion annosum is a fungus that attacks a wide variety of woody plants. All western conifer species are susceptible. Madrone (*Arbutus menziesii*), and a few brush species (*Arctostaphylos spp.* and *Artemisia tridentata*) are occasional hosts. Other hardwood species are apparently not infected. The disease has been reported on all National Forests in California, with incidence particularly high on true fir in northern California, in the eastside pine type forests, and in southern California recreation areas.

Annosus root disease is one of the most important conifer diseases in Region 5. Current estimates are that the disease infests about 2 million acres of commercial forestland in California, resulting in an annual volume loss of 19 million cubic feet. Other potential impacts of the disease include: increased susceptibility of infected trees to attack by bark beetles, mortality of infected trees presently on the site, the loss of the site for future production, and depletion of vegetative cover and increased probability of tree failure and hazard in recreation areas.

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, or under the duff at the root collar. New infection centers are initiated when airborne spores produced by the conks land and grow on freshly cut stump surfaces. Infection in true fir may also occur through fire and mechanical wounds, or occasionally, through roots of stumps in the absence of surface colonization. From the infected stump surface, the fungus grows down into the roots and then spreads via root-to-root contact to adjacent live trees, resulting in the formation of large disease centers. These infection centers may continue to enlarge until they reach barriers, such as openings in the stand or groups of resistant plants. In pines, the fungus grows through root cambial tissue to the root crown where it girdles and kills the tree. In true fir and other non-resinous species, the fungus sometimes kills trees, but more frequently is confined to the heartwood and inner sapwood of the larger roots. It then eventually extends into the heartwood of the lower trunk and causes chronic decay and growth loss.

Heterobasidion annosum in western North America consists of two intersterility groups, or biological species, the 'S' group and the 'P' group. These two biological species of *H. annosum* have major differences in host specificity. All isolates of *H. annosum* from naturally infected ponderosa pine, Jeffrey pine, sugar pine, Coulter pine, incense cedar, western juniper, pinyon, and manzanita have, to date, been of the 'P' group. Isolates from true fir and giant sequoia have been of the "S" group. This host specificity is not apparent in isolates from stumps; with the 'S' group being recovered from both pine and true fir stumps. These data suggest that infection of host trees is specific, but saprophytic colonization of stumps is not. The fungus may survive in infected roots or stumps for many years. Young conifers established near these stumps often die shortly after their roots contact infected roots in the soil.

Western Gall Rust

Western gall rust (<u>Peridermium</u> <u>harknessii</u>) causes branch galls and trunk cankers on nearly all species of hard pines. The rust fungus produces yellow to orange-colored spores (aeciospores) on the surface of the galls during cool, moist, spring weather the second or third year after infection. New crops of spores are produced yearly thereafter until the host tissue dies. Dispersal of spores by wind occurs usually in May and June. After spores land on susceptible tissues, especially after rainfall, some germinate and cause new infections. Most infections occur on current-year shoots. There is considerable yearly variation in the amount of infection in the West, where abundant infection in given stands occurs in relatively few years.

The fungus infects pines of all sizes and ages. Seedlings are the most susceptible and are often killed within a few years by girdling stem galls. In nurseries, galls may develop on seedlings as a result of infection by spores from surrounding infected stands and windbreak trees. Branch infections on mature trees usually are of slight importance; however, branch infections of highly susceptible trees may exceed 100 galls and consequently would reduce growth potential. Stem infections can result in growth loss and cull. Galls resulting in cankers may continue to grow slowly for more than 200 years eventually resulting in stem deformity. Cankers form weak points making stems and branches susceptible to wind breakage. Cankers also create avenues through which decay fungi can enter stems.

Dwarf Mistletoe

Dwarf mistletoes (Arceuthobium spp.) are parasitic, flowering plants that can only survive on living conifers in the Pinaceae. They obtain most of their nutrients and all of their water and minerals from their hosts.

Dwarf mistletoes spread by means of seed. In the fall the fruit ripen and fall from the aerial shoots. The seeds are forcibly discharged. The seed is covered with a sticky substance and adheres to whatever it contacts. When a seed lands in a host tree crown, it usually sticks to a needle or twig, where it remains throughout the winter. The following spring the seed germinates and penetrates the twig at the base of the needle. For the next 2-4 years, the parasite grows within the host tissues, developing a root-like system within the inner bark and outer sapwood, and causing the twig or branch to swell. Aerial shoots then develop and bear seed in another 2-4 years.

Dispersal of dwarf mistletoe seeds is limited to the distance the seeds travel after being discharged. From overstory to understory, this is usually 20 to 60 feet, but wind may carry them as far as 100 feet from the source. A rule of thumb is that the seeds can travel a horizontal distance equal to the height of the highest plant in an infected tree. There is some evidence that long distance spread of dwarf mistletoe is occassionaly vectored by birds and animals.

Vertical spread within tree crowns of most dwarf mistletoes is limited to less than one foot per year because of foliage density. Because of the thin crowns of gray pine, however, the vertical rate of spread has been measured as being greater than 2 feet per year. This rate of spread equalled or exceeded the rate of height growth of infected trees.

Dwarf mistletoes are easy to identify because they are generally exposed to view within a tree's crown. Signs of infection include the yellow-green to orange mistletoe plants, basal cups on a branch or stem where the plants were attached, and detached plants on the ground beneath an infected tree. Symptoms include spindle-shaped branch swellings, witches' brooms in the lower crown, and bole swellings.